APPLICATIONNOTE

The content of this note is based on information received from manufacturers in the electrical and electronics industries or their representatives and does not imply practical experience by Elektor Electronics or its consultants.

TinyLogic ICs Type NC7SZ57/58

Configurable logic gates

Source: Fairchild Semiconductors

The thing about these TinyLogic integrated circuits from Fairchild's UHS series is that they allow up to five different gate combinations to be created, including versions with two identical inputs, or an inverting and a 'true' input.

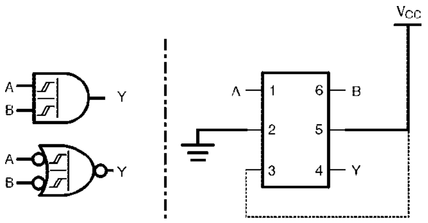

FIGURE 1. 2-Input AND Gate

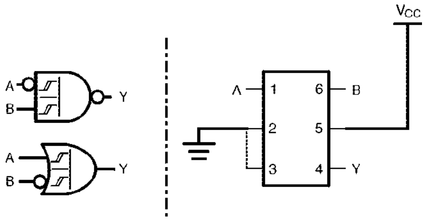

FIGURE 2. 2-Input NAND with inverted A Input

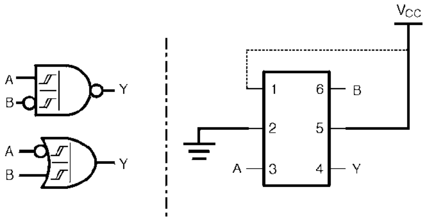

FIGURE 3. 2-Input NAND with inverted B Input

Figures 1-10. Overview of TinyLogic configuration options.

Fairchild's 'TinyLogic' family was originally introduced about five years ago. The series comprises a wide range of single and dual gate logic functions in a number of small SMD enclosures (hence 'tiny'). Compared with the commonly seen 'small outline' cases of similar CMOS ICs, TinyLogic devices offer considerable space savings on printed circuit boards.

All members of the TinyLogic family are marked by high speed and low power consumption. These features, in combination with their small size, make the devices eminently suitable for application in portable equipment like portable CD-players, GSM phones, PDAs and laptop computers, where space is at a premium.

Within the family, a number of sub-series may be identified: HS, HT, UHS and, recently, the ULP series. The respective acronyms stand for 'high speed', 'high-speed TTL compatible', 'ultra-high speed' and 'ultra-low power'. The devices discussed in this article belong in the UHS series which is marked by a supply voltage range of 1.65 V to 5.5 V and very high switching speeds. Compared with 'ordinary' HC logic the speed of the NC7SZ devices is more than twice as high at just 2.8 ns typical (at 5 V supply voltage). Another extremely welcome characteristic of these ICs is that their outputs can supply a current of up to 32 mA. This makes them suitable for direct driving of LEDs, optocouplers and low-power relays.

One IC, five functions

Notwithstanding the great value of the above mentioned specifications, undoubtedly the most striking thing about the NC7SZ57 and –58 is that each of these can be configured for five different logic functions. Simply by 'rearranging' the connection of the output pins, the IC allows all standard logic functions with two inputs to be implemented. The inset table and the associated **Figures 1 through 10** illustrate how this may be achieved in practice.

Figures 1 through 5 cover the NC7S57 and Figures 6 through 10, the NC7SZ58. All inputs feature hysteresis.

Table 1. Configurations

2-Input Logic Function	Type	Circuit
2-Input AND	NC7SZ57	Figure 1
2-Input AND with one inverting input	NC7SZ58	Figure 7, 8
2-Input AND with two inverting inputs	NC7SZ57	Figure 4
2-Input NAND	NC7SZ58	Figure 6
2-Input NAND with one inverting input	NC7SZ57	Figure 2, 3
2-Input NAND with two inverting inputs	NC7SZ58	Figure 9
2-Input OR	NC7SZ58	Figure 9
2-Input OR with one inverting input	NC7SZ57	Figure 2, 3
2-Input OR with two inverting inputs	NC7SZ58	Figure 6
2-Input NOR	NC7SZ57	Figure 4
2-Input NOR with one inverting input	NC7SZ58	Figure 7, 8
2-Input NOR with two inverting inputs	NC7SZ57	Figure 1
2-Input XOR	NC7SZ58	Figure 10
2-Input XNOR	NC7SZ57	Figure 5

User friendly

The TinyLogic ICs come in an 'SC70' SMD case which is only 2 mm long! The pin connections are shown in **Figure 11**, while the pin states are listed in a separate table.

Remarkably, and in contrast with what we would expect, each TinyLogic gate has its own case. It is also unusual that the case does not have a mark to identify pin 1. Here, the print on the device tells us the location of pin 1. If the print is legible, pin 1 is below at the left.

When designing a PCB and constructing a circuit, there are certain advantages to having just one gate in one integrated circuit. For example, the logic gate may be inserted directly in the signal line, without having to run tracks up and down the board to a central IC containing, say, four such gates. The result is

Table 2. Electrical Data

Absolute Maximum Ratings

DC Electrical Characteristics

Supply Voltage (V_{CC})	–0.5 V to +7.0 V
DC Input Voltage (V_{IN})	–0.5 V to +7.0 V
DC Output Voltage (V_{OUT})	–0.5 V to +7.0 V
DC Input Diode Current (I_{IK})@ $V_{IN} \leq 0.5$ V	–50 mA
DC Output Diode Current (I_{OK}) @ $V_{IN} \leq -0.5$ V	–50 mA
DC Output Source/Sink Current (I_{OUT})	±50 mA
DC VCC or Ground Current (I_{CC} / I_{GND})	±50 mA
Storage Temperature Range (T_{STG})	–65°C to +150°C
Max Junction Temperature under Bias (T_J)	150°C
Lead Temperature (T_L) (Soldering, 10 seconds)	260°C
Power Dissipation (P_D) @ +85°C SC70-6	180 mW

Recommended Operating Conditions

Supply Voltage Operating (V_{CC})	1.65 V to 5.5 V
Supply Voltage Data Retention (V_{CC})	1.5 V to 5.5 V
Input Voltage (V_{IN})	0 V to 5.5 V
Output Voltage (V_{OUT})	0 V to V_{CC}
Operating Temperature (T_A)	–40°C to +85°C
Thermal Resistance (θ_{JA}) SC70-6	350°C/W

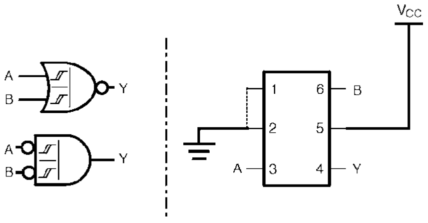

FIGURE 4. 2-Input NOR Gate

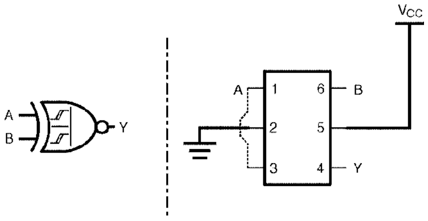

FIGURE 5. 2-Input XNOR Gate

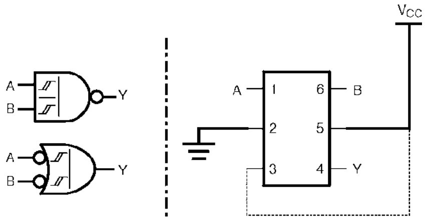

FIGURE 6. 2-Input NAND Gate

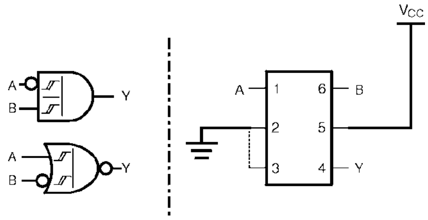

FIGURE 7. 2-Input AND with inverted A Input

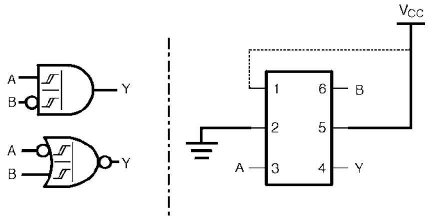

FIGURE 8. 2-Input AND with inverted B Input

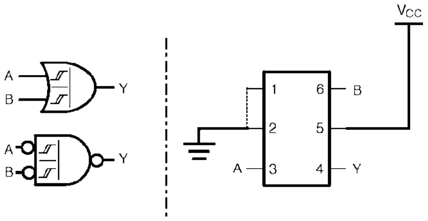

FIGURE 9. 2-Input OR Gate

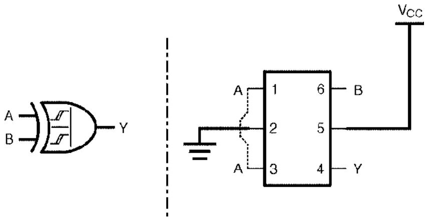

FIGURE 10. 2-Input XOR Gate

shorter connections with all the well-known benefits for the actual operation of the circuit. Besides, PCB designers have more freedom in doing the board layout, which does not require a total redesign following every minor change to the circuit.

Conclusion

Summarizing, we can say that these TinyLogic gates are a useful addition to the usual collection of logic components. TinyLogic devices are small, fast, economical and their ease of configuration makes them really versatile.

To close off this short article, we should not forget to mention the main electrical specifications of the NC7SZ57 and –58; see the second table.

Those of you with a deeper interest in these unusual but useful ICs are referred to the TinyLogic datasheets published by Fairchild. These may be downloaded free of charge from this url:

www.fairchildsemi.com

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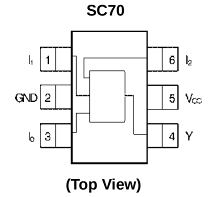
Pin Descriptions

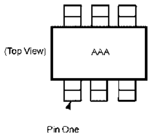
Pin Name	Description
I_0, I_1, I_2	Data Inputs
Y	Output

Function Table

Inputs			NC7SZ57	NC7SZ58
I_2	I_1	I_0	Y $(\overline{I_0})(\overline{I_2})(I_1)(I_2)$	Y $(I_0)(\overline{I_2})(\overline{I_1})(I_2)$
L	L	L	H	L
L	L	H	L	H
L	H	L	H	L
L	H	H	L	H
H	L	L	L	H
H	L	H	L	H
H	H	L	H	L
H	H	H	H	L

H HIGH Logic Level L LOW Logic Level





AAA Product Code Top Mark - see ordering code

Note: Orientation of Top Mark determines Pin One location. Read the top product code mark left to right, Pin One is the lower left pin (see diagram).

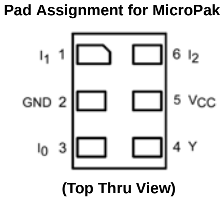


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Figure 11.Case, pinout and pin states.